

Application No.: 10/776852
Amendment dated: January 13, 2005
Reply to Office action of October 13, 2004

REMARKS/ARGUMENTS

Claim 1 has been rejected under 35 U.S.C. §103 on Shimano in view of Ohnishi, and a similar rejection has been made on Okui in view of Ohnishi. The applicant requests reconsideration of these rejections for the following reasons.

The rejection on Shimano in view of Ohnishi essentially begins with the premise that one skilled in the art would have selected the crank-to-cam chain and the cam-to-cam chain in Shimano in accordance with strength requirements. Then, the Examiner concludes that it would have been obvious to use a chain having a greater pitch for the crank-to-cam chain because, as shown by Ohnishi, a stronger chain has a greater pitch.

There are flaws in the line of reasoning summarized above.

Shimano et al. do not make a distinction between their crank-to-cam chain and their cam-to-cam chain. Apparently the chains are the same. Thus, if one begins by considering the conditions present in the Shimano timing transmission, one will first observe that the crank-to-cam chain must bear the load of four cams, whereas each cam-to-cam chain need only bear the load of one cam. In Shimano, the maximum load is sustained by the crank-to-cam chain. Therefore, assuming that Shimano's chains are all the same, their strength is dictated by the strength requirement imposed by the crank-to-cam transmission path, not by the cam-to-cam transmission path. One does not begin by observing that the cam-to-cam chains are relatively weak chains and the crank-to-cam chain needs to be stronger. Rather, one might observe that the crank-to-cam chain needs to have a certain strength, but the cam-to-cam

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chains do not need to be as strong, and can therefore have a strength less than that of the crank-to-cam chain.

It does not follow, however, that one would automatically make the pitch of the cam-to-cam chains less than that of the crank-to-cam chain. Indeed, although Ohnishi's graphs show that, for certain standard roller chains and B-type chains, rupture strength and the fatigue limit both tend to be greater for chains having a greater pitch, it does not follow that a chain having a lower strength must always have a smaller pitch, or for that matter, that a chain having a greater strength must always have a larger pitch. In other words, at least for some chains, chain strength is directly related to pitch as a general proposition, but that is a far cry from saying that, when one wants a chain having reduced strength, one must necessarily adopt a chain having a smaller pitch. Chains having the same pitch can have different strengths. Moreover, chains having a small pitch can have a strength greater than that of chains having a larger pitch.

Nor does it follow that one skilled in the art would be motivated to depart from the uniform chain pitch of Shimano et al. by making the pitch of the cam-to-cam chains smaller than the pitch of the crank-to-cam chain. As pointed out previously, the diameter of the crankshaft cam in Shimano is nearly the same as the diameter of each of the small camshaft sprockets, and accordingly the obvious choice is to adopt a cam-to-cam chain (and corresponding cam-to-cam drive sprockets) that have a pitch the same as that of the crankshaft sprocket, the larger cam sprocket, and the crank-to-cam chain.

The rejection on Okui in view of Ohnishi is substantially identical to the rejection on Shimano et al. in view of Ohnishi. In FIG. 1 (of 6,250,266), Okui shows a V-type

Application No.: 10/776852
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engine having two DOHC timing drives, each having a configuration corresponding to that of the Applicant's drive; that is a crankshaft sprocket driving a large camshaft sprocket through a first drive chain, and a smaller crankshaft sprocket coaxial with the larger camshaft sprocket and driving the other camshaft sprocket through a second drive chain. In this case, since each crank-to-cam chain drives two cams, and the diameter of the larger camshaft sprocket is twice that of the crankshaft sprocket and about twice that of each of the smaller camshaft sprockets, both chains apparently sustain about the same tensile load, and there is no motivation to make them different, either in strength or in pitch.

Moreover, for the same reasons as given above in connection with the rejection on Shimano in view of Ohnishi, there is no motivation to make the chains of Okui different in pitch.

New dependent claim 3 further distinguishes the invention from Shimano in that it recites that the crankshaft sprocket and the large camshaft sprocket constitute all of the sprockets around which the driving chain is wrapped. (Claim 1 has been revised to make it clear that the crankshaft sprocket and large camshaft sprocket, when referred to in new dependent claim 3, are only two sprockets. This is not a narrowing amendment.) In contrast, Shimano's driving chain is wrapped around the crankshaft sprocket as well as around two larger camshaft sprockets. Even if the teachings of Ohnishi had made it obvious to make the pitch of the cam-to-cam chains in Shimano less than the pitch of the crank-to-cam chain, the result would not correspond to claim 3. Moreover, for the reasons stated above in connection with Okui, even though one might perceive a reason to make the cam-to-cam chains in Shimano less strong than the crank-to-cam chain, there is no apparent motivation to do so in the case of Okui. In applying

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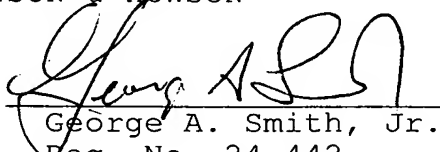
the prior art to claim 3, one does not even reach the question of whether or not it would have been obvious to utilize a cam-to-cam chain having a smaller pitch.

In summary, while Ohnishi shows a general tendency for the strength of some chains to increase with increasing pitch, it does not follow that one skilled in the art would select a chain having a smaller pitch whenever he desired to provide a chain having less strength, or that he would select a chain having a greater pitch whenever he desired to provide a chain having greater strength. Moreover, in the case of a timing drive in which a separate crank-to-cam chain serves each line of cylinders (as in claim 3), the prior art does not even supply a motivation to make the strengths of the chains different from each other, and consequently, even if chain pitch always varied directly with chain strength (or vice-versa), the prior art would not establish that claim 3 is unpatentable.

For the reasons set forth above, the prior art does not establish that the invention as claimed would have been obvious to a person of ordinary skill in the art. Favorable reconsideration and allowance of this application are therefore respectfully requested.

Respectfully submitted,
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